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on the Great Lake in Cambodia

CONSIDERATIONS ON THE UTILIZATION OF RADIOISOTOPES FOR THE STUDY OF SEDIMENT TRANSPORT

by J.P. Carbonnel, Sedimentologist

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In 1960, the International Atomic Energy Agency sent out an expert mission to study the possible applications of radioactive isotopes in studies of the Lower Mekong Basin. The report (A.I.E.A. - RI/10) by Mr. Eriksson and Mr. Hours was the result of that investigation. The authors of the report specially emphasize two possible utilizations of radioisotopes in this field: tracer methods for water discharge measurement and tracer methods for bed load transport. Concerning the latter, they consider two methods according to the type of sand transport and river regime, namely, the pulse method and the integration method. In this note, we shall not repeat their considerations on these methods.

In document WRD/MKG/INF/L.85, dated 16 February 1962, IAEA suggested a draft plan for radioactive tracing of bed load in the River Stung Sen in Cambodia. This programme, which is divided in two phases, appears to satisfy the necessary conditions of the envisaged method. It is a sensible programme. However, it might be useful for us to bring certain points into clearer focus and report on our present knowledge of conditions of sedimentation and bed load transport in the River Stung Sen.

DESCRIPTION OF THE PROBLEM

The final result of investigations should be to construct a discharge bed load transport graph. For a substance of a particular grain such a curve will show a specific point of origin corresponding to the threshold of movement of the substance in question. This threshold varies with the discharge, i.e. the flow velocity, whether increasing or decreasing (rising or subsiding flood).

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Therefore, it may be seen that this is a very complex problem, which involving several more or less well defined parameters:

(1) It is necessary to have a good knowledge of the hydrologic conditions of the river in order to forecast discharges at the beginning and during the experiment and thus to regulate the conditions of the experiment, in particular as concerns the size of the radioactive substance to be used. This knowledge is fundamental, because any error in computation of the size of the grains entails the risk of contaminating the site of the experiment with too large radioactive elements which will not "take of", or will too small elements which will be lost between the time of introduction in the stream and the time of the first measurement.

Now, the discharge hydrographs of the Stung Sen are very imperfectly known and if it may be expected that they will be better known in one year's time, in any case it will be at one point only, i.e. at Kompong Thom.

(2) The obverse problem is as follows: knowing the discharges, what is the size of the transported grains? This problem has been solved theoretically in the laboratory, but on the field the geomorphologic conditions, and also the conditions of the former deposits (mixture of variously-sized fractions, compaction), may modify the results obtained in the laboratory. Hence, it is necessary to investigate the sandy formations of the river before attempting any experiment with radioactive particles. We deliberately use the term "experiment", because it is useful to recall that the utilisation of radioisotopes in this field is still in the experimental stage.

However, it may well be that this method will be the method of the future in this field, for which no perfectly accurate method has been developed to-date.

/ OBSERVATIONS

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We have been able to make some observations on the flow of the Stung Sen and those observations show how necessary it is to undertake, as an indispensable preliminary condition, a detailed survey of the sedimentation regime of that river.

In particular, we observed a difference in the sedimentation process, hence in transport, of the sands of the Stung Sen between Kompong Thom and the mouth of the river. At Kompong Thom the bed of the river is formed by dunes, whereas at Kompong Chamlang, where we have taken samples, the bed presents the aspect of a clay depression with a central channel, often narrow, composed of sand. In the channel, the sand appears to "flow" as a river within the river.

Shallow soundings have enabled us to realize how the process of sand transport works. We give in appendix to this note two sections of the Stung Sen, in each of which we have effected three soundings. These soundings can easily be interpreted:

- In the centre of the Stung there is a large mass of sand, generally from medium to fine, in rare cases very fine, with a comparatively homogeneous grain.

- On the flanks of the Stung, alternating layers of sand (generally very fine) and clay, the latter usually containing very fine strata of organic debris, leaves lying flat according to stratification, twigs, etc.

In consequence, the transport process can be envisaged as follows: there is a permanent sand channel in the axis of the Stung:

- In flood time, the sand starts moving and, according to the force of the transport agent, overflows from its permanent channel, with an intensity parallel to the intensity of the flood itself. Part of this sand then deposits on the sides of the river.

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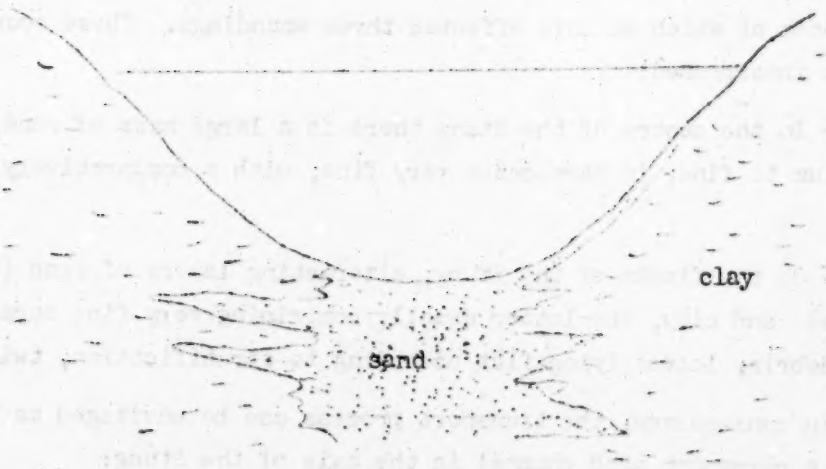
- During the next dry season, a thin layer of clay deposits over the sand.

The process is renewed at the next flood, which sweeps away part of the previously deposited clays. It should however be noted that in any particular point of the river bed we do not necessarily find a regular alternation of sand and clay strata, because for the "flood sand" to reach that point, it is necessary for the flood to exceed a specific intensity, which is a function of the distance of that point from the permanent channel.

In cross-section, we have a more or less extensive penetration of sand layers between the clay layers.

The following figure gives an idea of such a cross-section.



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In this particular case, it is easy to understand the complexity of the problem. And this represents only one type of bed load transport; there is certainly another type of process in the vicinity of Kompong Thom, where the sand is displaced by moving dunes. The latter method of transport is necessarily less rapid than the one previously described: any study of bed load transport should take this difference into account.

Following the above general considerations, it may be useful to recall the somewhat pessimistic conclusions (but it is necessary to see things as they are) of Mr. J. Tricart:

"The method of radioactive tracers is difficult to apply in river due to the following factors:

(a) Security conditions which comple immersion of the isotopes in conditions which are often not very suitable from the geomorphogic point of view.

(b) The necessity of multiplying experiments with excessively costly equipment.

(c) Difficulty of identifying the marked substances after transport.

(d) The impossibility of renewing an experiment as long as the radioactivity of the previously immersed substance persists".

("Critical analysis of experimental radioactive methods in problems of river dynamics" by J. Tricart 1962).

The above conclusions and our own observations lead us to hope that before undertaking investigation of sand transport in the Stung Sen by means of radioactive tracers, the following conditions will be fulfilled:

(1) Full knowledge of hydrologic conditions.

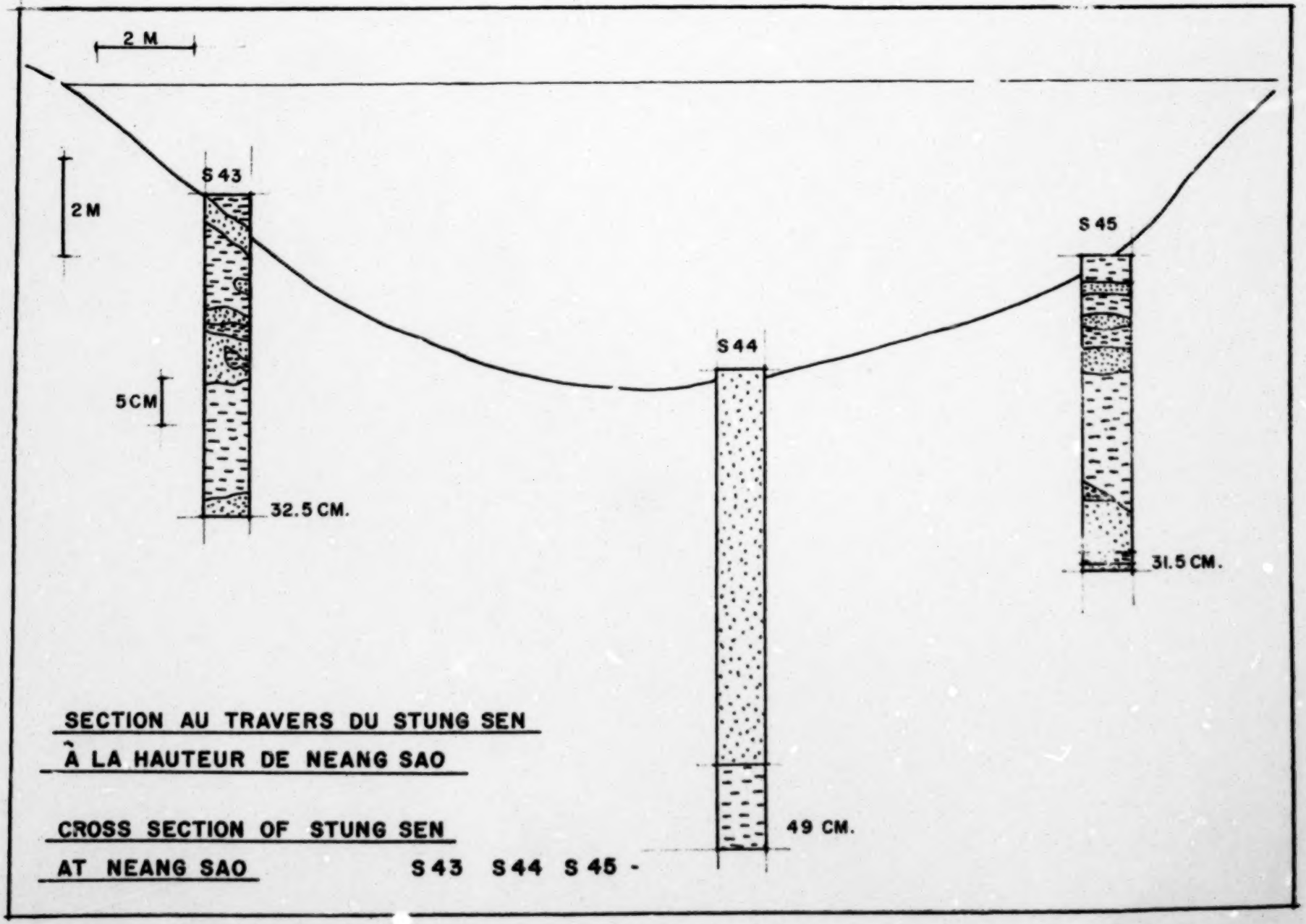
(2) The different types of formations of the Stung should be identified and mapped; a grain size study should be previously effected for each type.

/ (3)

(3) The team of sedimentation experts currently working in the field should be contacted and a cooperation programme should be organized.

Finally, we feel it would be very desirable that, simultaneously with this study, investigations based on other methods should be used to support it, in order to obtain satisfactory overall results (See the suggestions submitted in report WRD/MKG/INF/L.86, of 21 June 1962).

Phnom Penh, 26 August 1962



SECTION AU TRAVERS DU STUNG SEN
À LA HAUTEUR DE NEANG SAO

CROSS SECTION OF STUNG SEN
AT NEANG SAO

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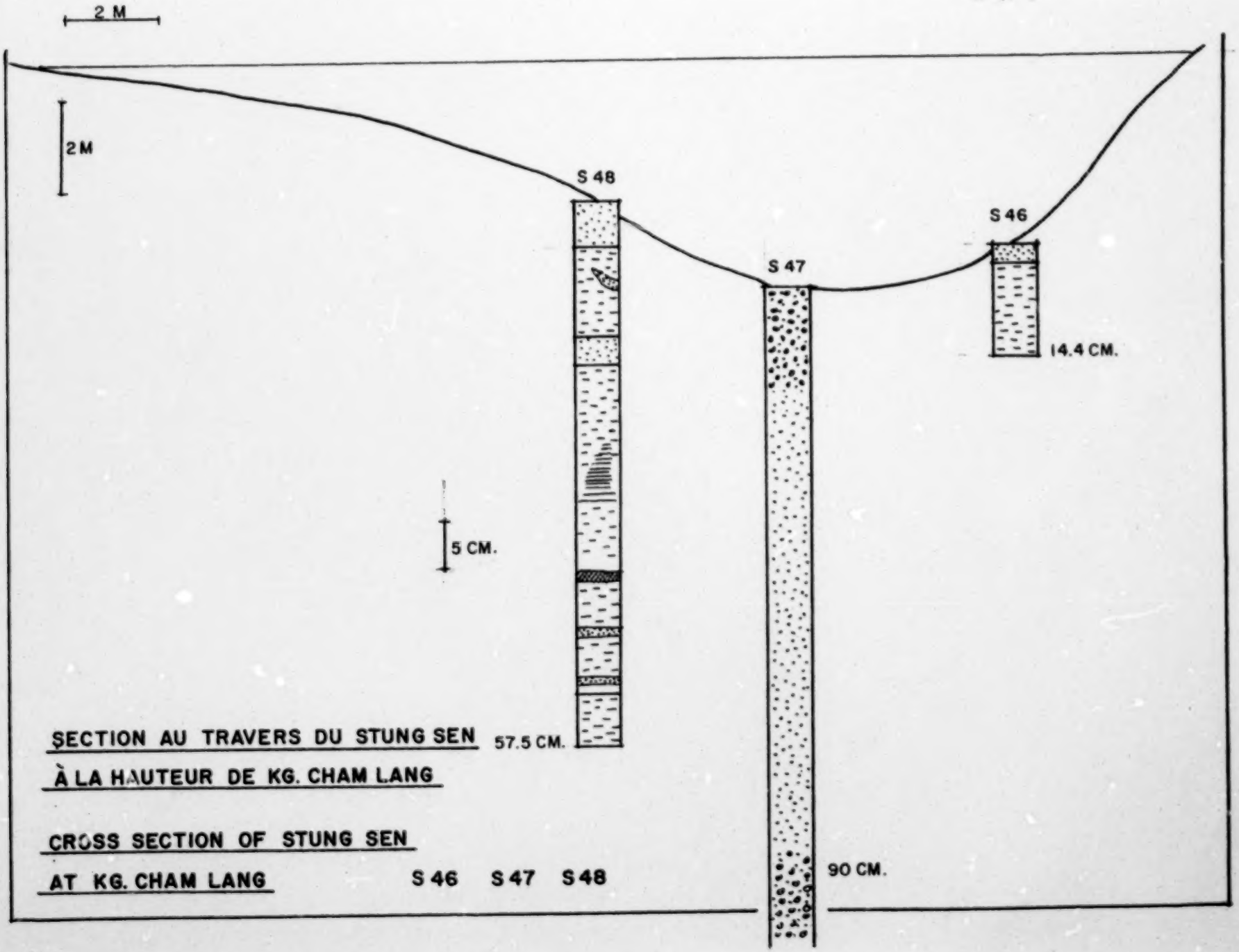

SECTION AU TRAVERS DU STUNG SEN
À LA HAUTEUR DE KG. CHAM LANG

CROSS SECTION OF STUNG SEN
AT KG. CHAM LANG

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